

**Abstract:**

A method is disclosed to heat a direct methanol fuel cell stack system at start-up without using any external energy source. During the start-up period, the fuel cell stack is at open circuit state so that the fuel cell stack is not connected to any external circuit. The methanol solution introduced at the anode side of the fuel cell stack will diffuse through the proton conductive membrane to the cathode side of the fuel cell stack. The methanol diffused from the anode side will be oxidized at the cathode side by oxygen in the air stream. This oxidation reaction generates heat that heats up the fuel cell stack and the system. The concentration of methanol in the methanol solution can be varied depending on the initial stack temperature. The lower the initial stack temperature, the higher the concentration of the methanol solution required. At an initial stack temperature of  $-40^{\circ}\text{C}$ , a solution having 40 wt% methanol is preferred to avoid freezing of the solution. If the initial stack temperature at start-up is above the freezing point of water, the methanol concentration in the solution can be in a range of 0.5 to 25 wt%, with a more preferred concentration range being from 3 to 10 wt% of methanol. The methanol solution and air feed rates can also be varied to control the rate at which heat is generated in the stack.